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Contribution from the Bureau of Plant Industry, Wm. A. Taylor, Chief.
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GROWING PEACHES:

SITES, PROPAGATION, PLANTING, TILLAGE, AND MAINTENANCE OF SOIL FERTILITY.[1]

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HISTORICAL NOTES.

ANTIQUITY OF PEACH GROWING.

The peach tree is unknown in the wild state except where circumstances firmly support the opinion that it has escaped from cultivation at some earlier time. Thus, in different parts of Asia and in Persia trees apparently wild have been observed. The latter country has been considered by some to be the source from which this fruit originally came. More than three centuries before the Christian era the peach is referred to as a Persian fruit. The Greeks and Romans received it soon after the beginning of that era, probably from Persia. But the antiquity of this fruit in China and its cultivation in that country for at least 2,000 years before the Christian era appears to be a matter of substantial proof, and its spread from China to India, to Persia, and to other parts of the Old World admits of a much more ready explanation than can its dissemination from any other country.[2]

INTRODUCTION INTO AMERICA.

There appears to be no definite record of the introduction of the peach into America. The Spaniards are said to have planted peach pits at St. Augustine, Fla., in 1565, or very soon thereafter. That the dissemination in the New World of peaches and other fruits with which the early colonists were familiar in their former homes was practically coincident with the establishment of homes in the new

[1] This bulletin is intended for general distribution. Farmers' Bulletins Nos. 632 and 633, continue the general subject of peach growing and treat of other fundamental orchard operations. In the preparation of this series of bulletins the author has very freely consulted the more important experiment-station literature on the subject, besides referring to many other sources of information. Credit is given wherever the information appropriated is tangible enough to warrant it.

[2] Those interested in a more detailed historical account of the peach should consult "Origin of Cultivated Plants," by Alphonse de Candolle.

country there can be no doubt. During the first 25 years of the seventeenth century the settlement at Jamestown received from the Old World several importations of seeds, cuttings, and scions of the things they wished to grow. It seems altogether probable that peach seeds or scions were included in these early importations. There is also good reason for assuming that peaches were introduced into New England in 1629, or very soon thereafter.[1]

The records which touch on peach growing during colonial times are very fragmentary, but enough can be learned from them to make it apparent that from the middle of the seventeenth century until the end of colonial days peach growing was gradually extended. Early in the nineteenth century some large orchards had been developed. One of them was in Accomac County, Va., where it is stated that in 1814 there was a peach orchard of 63,000 trees, the product of which was used for making brandy. Prior to 1850 many thousands of acres were devoted to peaches in New Jersey and Delaware.

Further reference to the early growth of peach culture can not be made in the present connection, but enough has already been indicated to make it clear that its development has followed more or less closely the development of the country itself.[2]

DISTRIBUTION AND STATISTICS OF PEACH GROWING.

There is no better way of showing the trend of the peach industry during the past generation, so far as the distribution of orchards is concerned, and its present extent, than by means of the census figures. The distribution of peach trees by States is not shown in the reports prior to that of the Eleventh Census (1890). Figures taken from that census and subsequent decennial reports which are of interest in the present connection are shown in Table I.

Perhaps there is no more interesting deduction to be made from the figures given in Table I than the widespread cultivation of the peach. In at least 39 of the 48 States there are peach interests of commercial importance. The limiting factor in the States where few trees are grown is doubtless extremely low winter temperatures. Yet in the milder portions of even these States, especially in protected locations, the growing of peaches is not an impossibility. It is obvious, however, that where the limit of possibility is approached, the number of crop failures may be expected to be large in comparison with the number of good crops.

[1] For a more complete account of the early introduction of fruit into the New World, see the article entitled "The fruit industry, and substitution of domestic for foreign-grown fruits," by William A. Taylor, in the Yearbook of the Department of Agriculture for 1897. Later this paper was republished as Division of Pomology Bulletin 7, with the same title.

[2] For an interesting account of the early development of peach growing in this country, see Smith, Erwin F., Peach Yellows: A Preliminary Report, U. S. Dept. of Agriculture, Section of Vegetable Pathology, Bulletin 9.

TABLE I.—*Distribution of peach trees,*[1] *by States, as shown by census reports.*

States.	Number of trees of bearing age—			Trees not of bearing age, Thirteenth Census, 1910.
	Eleventh Census, 1890.	Twelfth Census, 1900.	Thirteenth Census, 1910.	
New England:				
Maine	1,607	9,592	5,102	3,320
New Hampshire	19,057	48,819	57,571	35,213
Vermont	1,966	4,993	5,492	2,187
Massachusetts	87,004	301,405	154,592	162,114
Rhode Island	11,816	48,063	39,342	30,795
Connecticut	88,655	522,726	461,711	338,608
Middle Atlantic:				
New York	1,014,110	2,522,729	2,457,187	2,216,907
New Jersey	4,413,568	2,746,607	1,216,476	1,363,632
Pennsylvania	1,146,342	3,521,930	2,383,027	2,179,386
East North Central:				
Ohio	1,882,191	6,363,127	3,133,308	2,092,300
Indiana	953,980	2,925,526	2,130,298	1,145,479
Illinois	783,910	2,448,013	2,860,120	739,358
Michigan	1,919,104	8,104,415	2,907,170	2,901,090
Wisconsin	387	6,967	4,163	4,148
West North Central:				
Minnesota	334	1,626	1,571	3,837
Iowa	82,238	516,145	1,090,749	283,308
Missouri	1,999,474	4,557,365	6,588,034	1,404,429
North Dakota	.....	2	90	604
South Dakota	78	1,080	1,815	5,259
Nebraska	144,701	1,055,959	1,188,373	263,882
Kansas	4,876,311	5,098,064	4,394,894	620,709
South Atlantic:				
Delaware	4,521,623	2,441,650	1,177,402	212,117
Maryland	6,113,287	4,017,854	1,497,724	805,063
District of Columbia	1,521	149	330	1
Virginia	1,218,219	1,939,113	1,585,505	780,551
West Virginia	450,440	1,695,642	1,424,582	1,441,188
North Carolina	2,133,004	2,773,788	2,661,791	861,042
South Carolina	711,138	1,136,790	1,336,142	349,790
Georgia	2,787,546	7,668,639	10,609,119	1,531,367
Florida	235,936	354,208	290,850	156,782
East South Central:				
Kentucky	1,205,866	2,884,193	2,245,402	1,110,744
Tennessee	2,347,699	2,749,203	3,163,737	1,190,727
Alabama	1,280,842	2,690,151	3,177,331	838,866
Mississippi	878,569	1,856,743	1,726,298	724,895
West South Central:				
Arkansas	2,769,052	4,062,218	6,859,962	2,884,927
Louisiana	317,132	758,877	903,352	316,132
Oklahoma	206	[3] 5,848,808	4,783,825	2,574,680
Texas	4,486,901	7,248,358	9,737,827	2,958,813
Mountain:				
Montana	.....	1,670	538	3,386
Idaho	13,639	79,757	73,080	212,995
Wyoming	.....	9	46	419
Colorado	8,204	319,998	793,372	606,001
New Mexico	23,081	117,003	136,191	184,466
Arizona	24,954	67,073	51,415	32,562
Utah	68,121	409,665	544,314	651,233
Nevada	3,996	9,136	6,329	5,049
Pacific:				
Washington	72,701	226,636	536,875	1,028,141
Oregon	115,244	281,716	273,162	508,179
California	2,669,843	7,472,393	7,829,011	4,409,562
Total	53,885,597	99,916,598	94,506,657	42,266,243

[1] Includes also nectarines, but the number of trees is so small as to be practically negligible.
[2] Includes Indian Territory.

Attention may be directed to the wide differences in the number of bearing trees in certain States in the different 10-year periods, some of which indicate a very large increase, while others show a large decrease in the peach industry. It will be noted also that in some of the important peach-producing States in 1910 there were nearly as many trees—in several instances considerably more—*not* of bearing age than there were of bearing age.

LOCATION AND SITE.

The location of an orchard has to do with its general surroundings. It may relate to transportation facilities, markets, climatic conditions, and the geographical position of the district or region in which an orchard is placed, or, in other words, its local geography. The site has to do with the particular piece of land occupied by the trees. It relates to the soil, slope, atmospheric drainage, and other natural factors which affect the suitability of a given area of land for peach growing.

It should be obvious that a location, so far as its position in a State or region is concerned, may have every natural advantage as to climate, soil, and other local conditions for the successful growing of peaches and yet, because of its remoteness from a shipping station, distance from suitable markets, or even the impracticability of

FIG. 1.—A fairly typical peach-orchard site in the Allegheny Mountain district of West Virginia, this being in Morgan County. In many instances the soil and other conditions in the valleys between the ridges are not well suited for peaches, even though the ridges may be admirably adapted to them.

supplying ice for refrigerator cars, it may be impossible to grow peaches there and market them profitably. Moreover, a location may have all of these advantages to a satisfactory degree and yet not be a desirable one for commercial peach growing because the markets within its logical radius for distribution are already abundantly supplied with peaches from districts which in some important respects are more advantageously placed.

It is likewise true that within a district which as a whole is well located for commercial peach growing there may be and usually are sites which are not adapted to this purpose, for reasons that are entirely local. This is especially apt to be the case in mountainous districts or wherever the topography is much broken and soil conditions are very variable. Especially careful discrimination in the selection of sites for orchards is essential in such districts. Figures 1 and 2 show typical orchard sites in important peach-growing districts in mountainous sections in widely separated parts of the country.

SITES WITH REFERENCE TO SOIL.

It is the current opinion that the peach should be planted on sandy or some of the lighter types of soil. While it is true that excellent results may follow the planting of orchards on such soils, it is equally true that peaches do well on a wide range of soil types, including even some of the moderately heavy clay loams and clays. But whatever the type, a soil must be thoroughly well drained to be suitable for peaches. They will not succeed on poorly drained soils. It follows that the heavy clay types which are so hard and impervious that water does not percolate through them readily are to be avoided. Moreover, a soil should be moderately fertile. One very rich in nitrogen is not to be desired as a general rule, since it is likely to induce an excessive growth of foliage. On the other hand, the impression which is somewhat common that a poor, unfertile soil is "good enough for peaches" is erroneous.

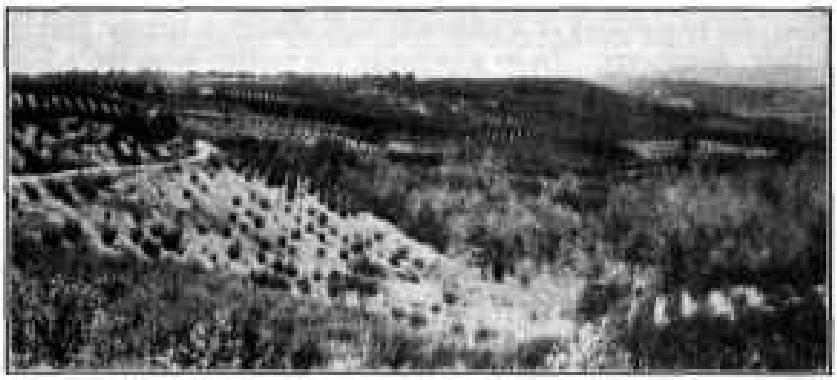

FIG. 2.—A fairly typical peach-growing section in a foothill district in California, this being in Placer County. Though the topography is much broken, these orchards are all irrigated.

In districts in which alkali soils occur, sites should be selected with a view to avoiding them. While the peach tree can be grown where there is a limited amount of the alkali salts, they cause disaster if present in large quantities. It is safer, therefore, to avoid them as far as possible.

SITES WITH REFERENCE TO ELEVATION.

As a general proposition, a site that is elevated considerably above the surrounding areas is to be preferred for a peach orchard. Relative elevation is generally of greater importance than actual elevation above sea level.

It is a well-recognized fact, though one too often overlooked in selecting sites for orchards, that cold air settles to the lower levels. For this reason it is often colder at the lower elevations than it is at higher points in the same locality. This is what is meant by "atmospheric drainage." The occurrence of frost in low places when there is none on elevated areas is thus explained. For the same reason

peach buds are often winterkilled or the blossoms are injured by frost in the spring in low places when near-by orchards on higher elevations are injured much less, or even escape entirely. During the past few years the importance of selecting relatively high sites for peach orchards in order to avoid the effects of unfavorable temperatures has been emphatically demonstrated in many different parts of the country. There are, however, certain general exceptions to the foregoing statement. Where an orchard that is well elevated above the surrounding country is exposed to low temperatures which are accompanied by severe winds, the fruit buds are sometimes injured when in the orchards at lower levels in the same locality, where there is protection from the wind, no injury occurs. However, injury under these conditions is rather rare in comparison with that which occurs in orchards that occupy relatively low sites.

SITES WITH REFERENCE TO BODIES OF WATER.

Where an orchard occupies a site that is adjacent to a large body of water, the importance of a relatively high elevation largely, perhaps entirely, disappears. To be a factor in the matter, however, a body of water must be of sufficient size and depth to have an appreciable influence on the local climate. Because the water warms up in the spring more slowly than the atmosphere, it acts in effect as a refrigerator, making the temperature in its immediate vicinity colder than it is at points somewhat distant from it. For this reason, vegetation within the zone of this influence advances more slowly in the spring than it does outside of that zone. The tendency, frequently very marked, is for the blossoming of peach trees situated within the zone to be delayed until after the season of spring frosts is past.

In the fall, frosts are delayed in a similar manner, except that the large body of water, having absorbed much heat during the summer, cools off in the fall more slowly than the atmosphere, and hence it tends to keep the temperature within its zone of influence warmer than it would otherwise be.

It is because of these reasons that peaches are grown with marked success and injury to the crops by adverse temperature conditions is comparatively infrequent in the portions of New York and the Province of Ontario that border Lake Ontario; in Ohio along Lake Erie; in southwestern Michigan on Lake Michigan, and in some other districts which are adjacent to large bodies of water. As a rule, the zone of influence of bodies of water, such as those named, is rather narrow, usually not extending back from the shore more than a few miles. However, the topography, and especially the degree of the slope of the land from the water, determines quite largely the extent of the area affected thereby.

SITES WITH REFERENCE TO SLOPE.

The slope or exposure of a site is the point of the compass toward which the land inclines. A question very commonly asked is, "What

slope is best?" It is one that admits of no direct answer. No one slope is preferable under all conditions and in all regions. In fact, the influence which a particular exposure may have in the success of an orchard is probably much overemphasized in the popular mind.

As a rule, it is doubtless safe to assume that a site having a moderate slope in some direction is to be preferred for orchard purposes, other things being equal, to one that is level. One having a slope will usually have better soil and atmospheric drainage than a level area; but so far as these factors are concerned in the abstract, one slope may be as good as another.

An orchard that occupies a site which slopes away from the prevailing wind may be afforded a certain amount of protection therefrom in some cases, and in some regions there are well-marked soil differences on the different slopes of the ridges. These differences may be such as to make one slope better adapted to peach growing than another.

Probably in the minds of most fruit growers the chief difference between the different slopes in their relation to fruit growing is assumed to be a matter of temperature. That different slopes may have different temperatures seems to be made evident in the common observation in many peach districts by the rapidity with which snow melts on southern slopes in comparison with corresponding northern slopes. But this evidence is at the surface of the ground. A few feet above the ground, where the air has perfectly free circulation, the difference in temperature that may exist at the surface on two opposing slopes, if they are not too steep, largely disappears. Hence, the tops of the trees on different slopes may be in essentially the same temperature even though there are appreciable differences at the surface of the ground. However, the slope factor is largely one of degree, so far as it requires consideration in selecting orchard sites. Peach trees on a site having a very steep southern slope will usually blossom and the fruit will ripen somewhat earlier than on a corresponding northern slope, but where the differences in slope are only moderate their relative influence on the time of blossoming and ripening is not very marked. Whether early or late blossoming is desirable is largely a local matter and depends primarily on the relative dates of blossoming and the usual occurrence of spring frosts in any locality or on any site.

TEMPERATURE A LIMITING FACTOR.

Aside from the economic factors already referred to, the temperature is probably the most decisive limiting factor in the distribution of commercial peach growing. Usually the fruit buds are the first to suffer injury when the limit of endurance is passed. No absolute minimum temperature which the peach is able to withstand without injury can be given. The condition of the buds both with regard to their strength, vitality, and perfect dormancy, the duration of

the critical temperature, the climatic conditions following the cold period, perhaps the amount of moisture in the air during the period, and other factors all have an influence in the matter.

In many of the peach districts, however, the growers are always apprehensive of injury, even with buds in good condition and all other factors favorable, whenever the temperature reaches 10° to 20° F. below zero. While buds of many varieties often withstand temperatures considerably lower than this when all other conditions are favorable, such periods are usually anxious ones for those growers who have large interests at stake.

The occurrence from year to year of severe spring frosts over any site during the blossoming period of peaches precludes the practicability of devoting it to that fruit on a commercial basis. Similarly, regions in which protracted warm periods occur from time to time during the winter have usually proved to be uncertain for peaches. The trees become more or less active during the warm periods; the buds start enough to become tender and are injured later even by temperatures which may not be unseasonable for the latitude. Because of the fact that the winters in the middle and southern latitudes are more often characterized by periods sufficiently warm to start peach buds and because the trees are apt to blossom before warm weather free from frosts becomes continuous, winter and spring injury is sometimes experienced in these latitudes when peaches in the northern districts escape.

The use of orchard heaters offers a measure of relief under some conditions in districts that are subject to unseasonable spring frosts, but such districts are, nevertheless, seriously handicapped in comparison with those where disastrous frosts rarely occur.

PROPAGATION OF PEACH TREES.

The average peach grower is not concerned directly with the propagation of trees. It is generally more advantageous for him to purchase them from one who makes the growing of trees his special business than to grow them himself. However, the general features of propagation should be understood by those engaged in peach growing. They are, therefore, briefly outlined in the present connection.

The site selected for a peach nursery should be one that is well drained and where the soil, preferably, is rather light, though not necessarily sandy. It is important also that the soil should be rather rich, in order to insure as far as possible a satisfactory growth of the trees.

The details of propagating the peach begin with the pits or seeds from which the stocks are grown and on which the different varieties are budded. The pits are obtained by nurserymen from many different sources. They are handled in different ways, depending quite largely upon climatic conditions, the extent of the business, and other factors.

In the middle latitudes, where probably the largest peach nurseries are located, the pits are generally planted in the fall in rows 3 to 4 feet apart where the trees are to be grown. In the North the pits are sometimes stratified or bedded in the fall in moist sand, where they are under some degree of control, and the planting is delayed until spring. In either case, the action of the moisture and freezing temperatures results in the cracking of the "stones." If the pits have been stratified, the kernels are usually sifted from the stones and sand before planting. They are then handled in essentially the same manner as pits that are planted in the fall.

In very mild climates where there is little action from frosts or freezes, it is probably quite important to prevent the pits from ever becoming dry. If they are not planted as soon as they are removed from the flesh of the fruit, they should be held in such a manner as to prevent the loss of much moisture. Otherwise, a very slow and irregular germination would follow. However, pits that have become dry will frequently germinate fairly well without freezing, provided they are soaked in water for a sufficiently long time before being planted.

The usual method of propagation is by budding,[1] and the seedlings should be large enough to bud by midsummer. This is done largely during July and August, extending sometimes into September. The buds put in during these months should "take," that is, become attached to the stock, within a comparatively few days if the operation is successful; then they should remain dormant until the following spring. After the buds "take," it is a common practice to "lop over" the tops of the seedling stocks by cutting them nearly off just above the point where the bud is inserted. Subsequently, the tops are entirely removed, or the tops may be left until the following spring and then removed without being previously lopped over.

The trees are ready to be planted permanently in the orchard after they have made one season's growth in the nursery. These are known as "1-year-olds," and they comprise the great bulk of the trees that are delivered by nurserymen for fall and spring planting.

A limited amount of budding is done by some nurserymen in June. Buds inserted as early in the season as this are expected to start into growth with but little delay instead of remaining dormant until the next spring, as is the case with the buds that are put in later in the summer. The trees so grown are termed "June buds" and are ready for permanent planting the following fall. While some growers plant this grade of tree with a high degree of success, the majority prefer 1-year-old trees, as already stated. Trees older than one year should not be planted unless in very exceptional instances.

In California, the stocks which are budded during the summer are sometimes used the following fall and spring for planting orchards. This practice is commonly referred to as "dormant-bud" planting.

[1] The operation of budding is fully described in Farmers' Bulletin 157, entitled "The Propagation of Plants," a copy of which will be forwarded without cost on application to the Secretary of Agriculture.

REGIONS FROM WHICH TO OBTAIN TREES.

Correspondents frequently write to the Department of Agriculture asking, "Is it advisable to purchase trees from the South?" or "from the North?" or from some other section which the writer specifies. To such inquirers reply is habitually made to the effect that the section is unimportant so long as well-grown, healthy trees which are typical of the desired varieties are obtained, and that the growing of good trees depends upon favorable conditions and proper management in the nursery. These factors are not peculiar to any particular section or sections.

The inherent qualities of a variety do not change when the trees are grown in different sections of the country. If the variety is hardy, it will continue to be so; if it is susceptible to some disease, it is not made less so by growing the tree during its nursery period in some particular region.

Economy in transportation expenses suggests the wisdom of purchasing trees as near the place where they are to be planted as is practicable. Moreover, trees shipped long distances sometimes suffer injury if they are not properly packed or if they pass through severe extremes of temperature while in transit. And, other things being equal, the nearer the nursery is to the site where the trees are to be planted the shorter the period of time during which they are out of the ground. While this is not a matter of serious import, it is sometimes well worth consideration. On the other hand, differences in the price of trees of the same grade offered by different nurserymen, the desire to secure trees of some special varieties, or some other reason may make it preferable to ignore the relative proximity of nursery and orchard site and to be governed by other factors in placing the order for trees.

TREES FOR PLANTING.

As a rule, only thrifty, well-grown, well-rooted 1-year-old or "June-budded" trees that are free from injurious insect pests and fungous diseases should be planted. A thrifty, well-grown grade does not necessarily mean the largest trees which can be found in a nursery. On the other hand, medium-sized trees are probably fully as desirable for planting as the larger ones. The smaller grades in some cases may be made up of trees that are stunted and weak from some cause or other. Not infrequently they have poor root systems. The smaller trees can usually be bought at a lower price than the medium-sized and large ones, but they may prove costly in the end, especially if they are lacking in vitality and make a poor growth after being planted.

Peach trees are commonly graded according to their height. In properly grown trees, however, there is a pretty definite relation between the height and the size of the trunk or "caliper" of the

tree. The diameter of the stem is sometimes used as the basis for grading nursery stock. The grades, according to height, are designated as "3 to 4 foot," "4 to 5 foot," "5 to 7 foot" trees, etc. Figure 3 shows four trees of each of three different sizes or grades. The relative size and height are apparent. The heaviest grade (C) is composed of larger, more heavily branched trees than the smaller ones; but they are more bulky and heavier to handle, and it is a question whether they will develop into any better trees ultimately than the medium-sized grade. The smallest grade (A) is composed

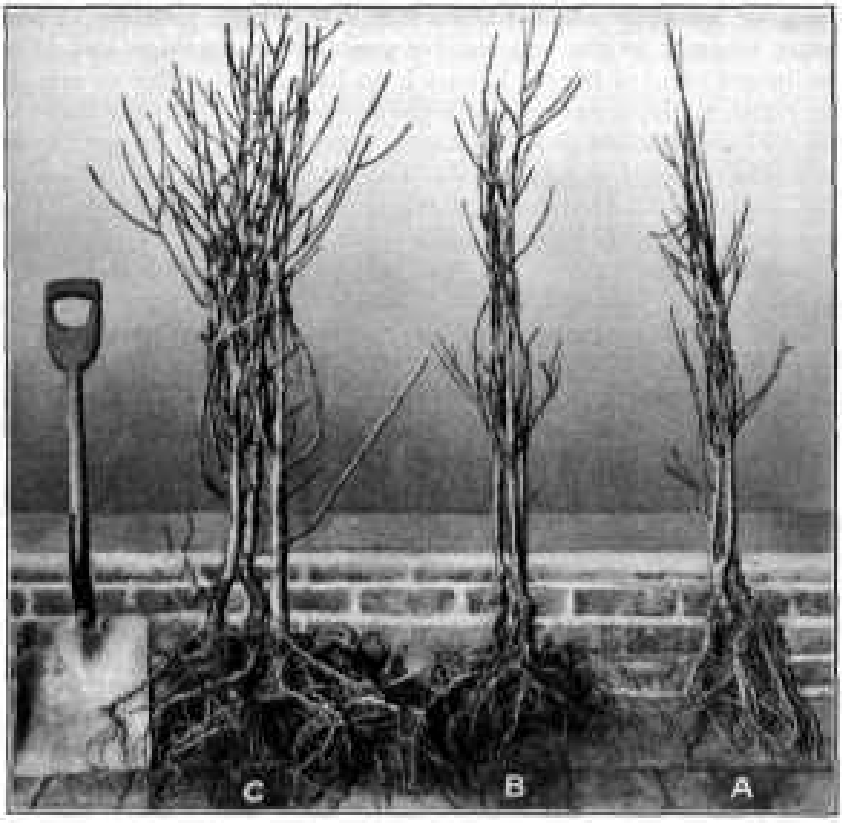

FIG. 3.—Nursery stock, showing different grades or sizes of 1-year-old peach trees: *A*, 3 to 4 foot grade; *B*, 4 to 5 foot grade; *C*, 5 to 7 foot grade.

of fairly good trees, but some of them may be lacking in vitality. Sometimes, for the sake of reducing the first cost, a grower buys even smaller trees than the 3 to 4 foot grade, but in most cases this proves to be false economy. A few cents per tree of additional cost means comparatively little in the initial expense of starting an orchard, but it may mean a vast sum later in the life of the orchard in the better development of good, vigorous trees.

Before planting an orchard, every prospective peach grower who has important interests at stake should form an accurate conception

of what constitutes good nursery trees in every respect. He should thoroughly familiarize himself with the appearance of the insects and diseases that are recognized as likely to be disseminated on nursery stock, and he should give particular attention to the character of the roots and their freedom from such diseases as crown-gall and hairy-root.

TIME OF PLANTING.

No arbitrary directions as to the time of planting peach trees can be given. In general, it may be stated that in the northern latitudes, or wherever the winters are rather severe, planting in the spring as early as the soil can be worked to advantage and after the danger of hard freezes is past is to be advised. But in middle and southern latitudes and in regions generally where the winters are mild and where the fall season is favorable for working the soil until late, the planting of trees at that season of the year is generally successful and by many is preferred to spring planting. The planting should be delayed until thoroughly well and naturally ripened trees can be obtained, but before the advent of really cold weather. It is desirable that fall-planted trees should reestablish some root action in their new positions before winter sets in. The danger of winter injury is thus reduced. But in some of the milder portions of the country, where the soil seldom freezes deep and rarely remains frozen for more than a few days at a time, peach trees are commonly planted at almost any time during the winter.

On the Pacific coast, where the annual climatic cycles divide the year into alternating "rainy" and "dry" seasons, the planting needs to be done with some reference thereto. The condition of the soil and the complete dormancy of the trees are the primary factors to be considered. In many parts of California, after the first rains have moistened the soil, usually early in January, the planting may be done to advantage, though some soils may be too cold and uncongenial at that time. Planting is usually deferred in such cases until early spring, though there is then some danger of the trees starting into growth before the soil reaches a suitable condition to be properly handled.[1]

HANDLING THE TREES WHEN RECEIVED FROM THE NURSERY.

After the delivery of the trees from the nursery to the place where they are to be planted, they should be unpacked immediately. Every possible precaution should be taken to prevent the roots from becoming dry. Unless the number of trees is so limited that immediate planting is possible, the trees should be heeled in. A thoroughly well-drained place, where the soil is mellow and deep, is required. A trench sufficiently wide and deep to receive the roots is made;

[1] Planting under California conditions is much more fully discussed by Prof. E. J. Wickson in "California Fruits and How to Grow Them."

then the trees are placed in it in the manner shown in figure 4. In covering, the soil should be worked among the roots of the trees sufficiently to fill all the spaces between them. This will fully exclude the air; otherwise, there is danger of the roots drying unduly. If a large number of trees are to be heeled in at the same place, it will usually be found convenient to place them in closely adjacent rows. When this is done, the trees in one row, for convenience, may be covered with the soil which is removed in opening the next adjacent trench. The rows may, of course, be made as long as circumstances dictate.

Trees that are tied in bundles when received must be separated before being heeled in. If this is not done, it is practically impos-

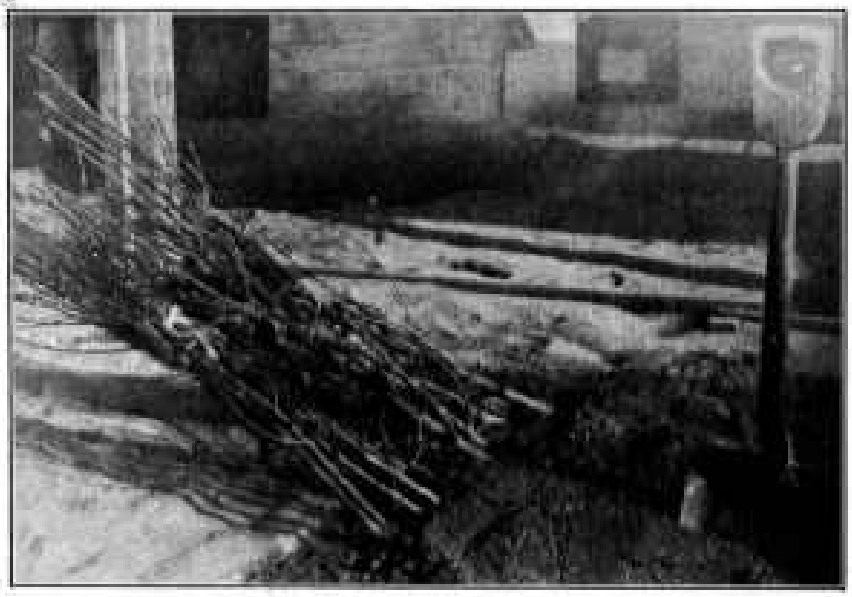

FIG. 4.—Peach trees heeled in. They may be held in good condition in this manner for a long time.

sible to work the soil among the roots sufficiently well to prevent them from drying to a serious extent.

Sometimes it is necessary to leave trees heeled in over winter. It is then well to place them in a position which is nearly horizontal, so that the entire portion of the trunks below the branches can be readily covered with soil for the purpose of protection. Such protection is of particular importance in the colder peach-growing districts. The soil should be made rather firm about the trunks and roots, so that harbors for mice will be reduced to a minimum.

PREPARATION OF THE LAND.

The ideal preparation of the soil where peach trees are to be planted consists of deep plowing and thorough pulverizing with the harrow or cultivator. The preparation should be hardly less thorough than for planting corn or sowing grain.

On the other hand, many degrees of compromise in this particular may be resorted to and still not defeat the end in view. For instance, the removal of stumps from newly cleared land is generally costly, except as it can be done with the regular force employed in the orchard and at times when other routine operations do not require attention. Where such land is to be devoted to peaches, it is practicable to remove the stumps from a narrow strip along the line of each row of trees. This course admits of a good preparation of the soil before the trees are planted and thorough tillage throughout the following season. Each season thereafter, the strip which is freed from stumps should be widened with a view to extending the cultivation accordingly. By the time the trees come into bearing, the stumps should be pretty well cleared from the entire area.

For reasons that are obvious, newly broken sod land can not be as readily fitted for the planting of trees as land that has been plowed a sufficient length of time for the sod to become well rotted.

PLANTING THE TREES.

Peach trees are planted at various distances apart, the topography of the land, the fertility of the soil, the varietal characteristics of the trees, and the preferences and conceptions of individual growers all being factors to be considered. Common distances are 18 by 18 feet, 18 by 20 feet, or 20 by 20 feet, requiring respectively 134, 121, and 108 trees per acre. Closer planting is sometimes practiced, but it is rarely advisable, while under some conditions 25 by 25 feet probably does not allow the trees more space than they need. The latter distances are probably used in California more often than in other portions of the country. The trees are usually planted in squares, as the above distances suggest, but the triangular system or some of its modifications is occasionally used.

The numerous methods that may be used in laying out a tract of land for the purpose of determining the proper points at which trees should be placed after the system of planting and the distances have been decided upon can not be described in the present connection. Every reasonable care, however, should be observed to plant the trees in straight rows and in perfect alignment in both directions. Trees which are so placed not only look better, but they can be cultivated better and more conveniently than where the rows are crooked and irregular.

Preliminary to digging the holes for the trees, some growers plow one or two furrows as deeply as is practicable along the line which marks each row, thus greatly reducing the amount of digging that must be done with a spade at the points where the trees are to stand. The holes should be broad enough to admit the roots without bending or crowding them from their natural positions, and of sufficient depth to allow the trees to be planted 2 or 3 inches deeper than they

were in the nursery. Correspondents frequently inquire about the advisability of making the holes considerably larger than the roots and filling in with rich soil. While there can be no objection to doing this, it adds materially to the expense of planting the trees, and there is probably little to be gained by it if the soil has been properly prepared and the subsoil is well suited to the object in view.

The use of dynamite in preparing the holes is also a subject of frequent inquiry. It is doubtless a fact that dynamite has a legitimate function in this connection, but most peach planters will probably do well to regard its use as still in the experimental stage. If a soil is well suited to peach growing, it is a question whether the use of dynamite will improve it materially. If the soil is not adapted to peaches, there is likewise a question as to whether the use of dynamite in preparing the holes can accomplish any permanent good. Moreover, under some soil conditions positive harm may result.

Some have argued that the exploding of a small charge of dynamite at the points where the trees are to stand so loosens the soil that the digging of the holes can be done enough more easily than where it is not used to pay for the extra expense of the explosive; but this depends very largely on the characteristics of the soil.

In some sections a thin stratum of hardpan or other impervious material occurs below the topsoil, while the subsoil beneath the impervious stratum is well suited to peach growing. Undoubtedly the use of dynamite as a means of breaking up such strata is entirely practicable and efficient when properly applied.

In preparing a tree for planting, all portions of the roots which have been mutilated in digging the trees or injured by any other means should be trimmed off, and long slender roots, if they occur, are usually cut off to correspond with the length of the general root system.

Unless a tree is rather large the branches should all be removed, leaving only a single unbranched stem, as shown in figure 5, *A*. This stem should be headed back to correspond with the height at which it is desired to form the head of the tree. The common extremes as to height of top preferred by different growers range from about 12 to 18 inches up to 24 or 30 inches.

But if the larger grades are planted—those, for instance, which are 6 feet or more in height—it is usually safer not to trim to a single unbranched stem. There might, then, not remain enough buds which would give rise to branches properly placed to make a good symmetrical head. It is therefore wise to select from 3 to 5 or 6 branches that are well distributed about the main stem, from which to develop the head. The limbs thus selected for the foundation of the top should be headed back to mere stubs, as shown in figure 5, *B*, but on each stub there must be left at least one well-developed bud to insure a starting point for the growth of the branch. With small and medium-sized grades there is little danger that an

abundant growth of desirable character will not develop from the main stem.

Sometimes between the trimming of the roots and the time when the trees are planted, there is danger of the roots, especially the smaller ones, becoming too dry. This danger can be largely eliminated by puddling them. This consists merely in dipping the roots in a puddle of clay. This should be of such consistency that a thin layer of mud will adhere to the roots when they are dipped into it and at the same time it should permit them to be moved about in it

FIG. 5.—Peach trees trimmed ready to plant: *A*, 4 to 5 foot grade; *B*, 5 to 7 foot grade.

with perfect ease and freedom. Such a coating of mud will afford considerable protection against undue drying out from exposure to sun and wind.

In planting the trees after they have been prepared as above suggested, several very important precautions should be observed. In filling the hole after a tree has been put in position and properly aligned, only finely pulverized soil should be used. In this part of the operation much care should be taken to work the soil in closely about the roots. This may be done to some extent with the fingers.

Moving the tree up and down very slightly as the hole is being filled will also help materially to settle the soil among the roots.

As the filling progresses, the soil should be firmly tamped about the roots either with the feet or with some sort of a plunger with which the end in view can be accomplished. The soil around the tree should be left about even with the general level of the surrounding surface.

TILLAGE.

Tillage refers to the work done with the plow, harrow, cultivator, or such other implement as may be used in working the soil after the trees are planted. The word "cultivation" is commonly used in the same sense, but as it is also given a broader meaning in some cases the term "tillage" is the more specific one in the present connection.

The objects of tillage have been comprehensively summarized as follows:[1]

(1) Tillage improves the physical condition of the land (*a*) by fining the soil and thereby presenting greater feeding surface to the roots; (*b*) by increasing the depth of the soil and thereby giving a greater foraging and root-hold area to the plant; (*c*) by warming and drying the soil in the spring; (*d*) by reducing the extremes of temperature and moisture.

(2) Tillage may save moisture (*e*) by increasing the water-holding capacity of the soil; (*f*) by checking evaporation.

(3) Tillage may augment chemical activities (*g*) by aiding in setting free plant food; (*h*) by promoting nitrification; (*i*) by hastening the decomposition of organic matter; (*j*) by extending these agencies (*g*, *h*, *i*) to greater depths of the soil.

It follows as a natural sequence that if there is sufficient tillage to properly maintain the physical condition of the soil and to well conserve the soil moisture, the other objects named in this summary will also probably be realized. An orchard should be tilled, if at all, for the sake of the trees and their product. If the soil conditions which are subject to influence by tillage exist in a particular orchard without it to an extent which is adequate for the needs of the trees and the production of good crops, then perhaps nothing is to be gained by tillage in that orchard so long as the results obtained are satisfactory and the trees remain in a vigorous, thrifty condition.

The continuous clean tillage of apple orchards is a mooted point with many growers. The exponents of each of the different methods of maintenance, which include clean tillage, sod mulch, etc., become skillful in adducing evidence, which to them is convincing, in support of their favorite systems. The fact is not as well recognized as it ought to be that at the basis of each successful system there are fundamental principles. If clean tillage is the best system under certain conditions and the sod-mulch system proves best under other conditions, the important thing is to determine what the relation of the different conditions is to the results obtained.

[1] Bailey, L. H. Principles of Fruit Growing, p. 139.

With particular reference to peach orchards, however, there is comparatively little difference of opinion in regard to tillage. While an occasional instance of a peach orchard which has been successful for a long time without tillage may be cited, the conviction of the best growers in practically all peach-producing sections is that thorough tillage is essential to the continued successful maintenance of an orchard.

"Thorough tillage" does not mean the same to every grower. To one it may consist of plowing the orchard in the spring and harrowing it once or twice later in the season; to another, who has a very high estimate of tillage as a means of preventing the evaporation of moisture from the soil, it may mean going over the orchard with some tillage implement 20 or 25 times during a dry season.

No arbitrary rules for tilling an orchard can be given. But if a grower keeps in mind the objects of tillage and understands the principles involved there should be little difficulty in deciding upon a rational plan of procedure.

Generally speaking, a peach orchard should be tilled throughout its entire life, beginning with the first season after the trees are planted. If, for the sake of economy or for other reasons, it is impracticable to work the entire area between the trees, it is usually feasible to confine the tillage for the first year or two to a relatively narrow strip along each row. But the width of the tilled strip should be extended each season and by the third year the entire surface should receive attention. By that time in the life of a peach tree the roots are extending beyond the spread of the branches and the entire space between the rows, where the trees have been planted the usual distances apart, is rapidly becoming filled with small rootlets and root hairs through which moisture and plant food in solution are taken up. The root development of peach trees, indicating the position of the roots with regard to tillage, and the application of fertilizers is suggested in figure 6.

Under what may be termed normal or standard conditions in most peach-growing districts the advice applies generally to begin the tillage in the spring as soon as the soil is in suitable condition to work. But in the case of bearing orchards, some of the wisest and most experienced growers prefer to wait until after the fruit has set before they begin, in the belief that the results of earlier tillage may influence adversely the setting of the fruit. The presence of a cover crop, its character, and the needs of the soil with reference thereto are other factors that may influence the date of beginning the tillage. The handling of cover crops is discussed on another page.

Conditions should determine what the nature of the tillage shall be. If the soil is hard or if there is a cover crop that has made considerable growth, it will be necessary to turn the soil with a plow and follow with a harrow, cultivator, or such other tillage implement as best suits the needs of individual orchards. If the soil is light,

plowing in the spring can sometimes be omitted, as some type of cultivator will be found adequate to pulverize thoroughly the soil to a sufficient depth. Whatever the details followed may be, they should be so directed as to keep the surface as level as possible. For instance, if the soil is plowed toward the trees at one time, it should be turned away from them at a later plowing.

In general, the orchard should be gone over with some kind of a tillage implement often enough to keep the soil thoroughly light and loose, or, in other words, in the condition of a dust mulch, for a depth of at least 3 or 4 inches. If a crust forms on the surface, or if the dust mulch becomes compact, evaporation of the moisture that is in the soil will become excessively rapid and an unnecessary and per-

FIG. 6.—A peach tree about 5 years old growing in "Porter's red clay" soil, Virginia. The spread of the branches was 18 feet. The spread of the roots, as traced, was 36 feet—17 feet on one side and 19 feet on the other.

haps serious loss of moisture which is needed by the trees will occur. As the surface is made compact by rain, it follows that tillage is advisable, as a rule, after each rainy period or after heavy showers; also as much more frequently as the impaired condition of the dust mulch may make necessary. In irrigated orchards tillage should generally follow soon after each application of water.

Tillage operations are usually continued, except in special cases, until midseason—the last of July or the first of August. By that time the growth of the trees for the season will have been largely made, fruit buds for the next season's crop will have begun to form, the fruit of the midseason varieties will have completed a large proportion of its growth, and the later varieties will finish their development

during a period when less moisture is required for the various functions of the tree than earlier in the season. Where cover crops or green-manure crops are desired, they should be sowed, in many cases, by this time.

As the trees become large, some of the extension types of tillage implements are advantageous, as they make possible the working of the soil under the branches without unduly crowding the team into the trees. In one of the large mountain peach orchards in West Virginia, where the broken topography of the land requires strong motive power for efficient work, the outfit shown in figure 7 has proved especially well adapted. The team of leaders is driven by a "jerk line," the driver riding the near pole horse. The man who rides the harrow not only serves the useful purpose of weighting it down, so that it will cut deep, but he also guides the harrow past the trees by properly adjusting the positions of its two sections. In this

FIG. 7.—An efficient outfit for the tillage of orchards where the topography is much broken and the draft is heavy.

way the trees are rarely injured, and yet the harrow can be run very close to them. However, in this particular orchard the use of the harrow is usually preceded by 2 or 3 bouts with a light 1-horse plow along each row of trees.

The leveler shown in figure 8 is also a very useful tillage implement in some orchard districts. Its use could doubtless be greatly extended to good advantage. Though of special importance in some of the irrigated districts for leveling the irrigation furrows, it is effective in crushing clods and in smoothing the surface of the soil. It is a home-made affair, consisting of two side pieces of 2-inch plank, 12 or 14 feet long and 6 to 8 inches wide. The crosspieces are 7 or 8 feet wide. The lower edges of the crosspieces where they come in contact with the ground are protected with strips of iron or steel to prevent undue wearing and also to give increased efficiency. Other details of construction are made sufficiently plain by the illustration.

MAINTAINING THE FERTILITY OF THE SOIL.

Fundamentally, the methods of maintaining or increasing the fertility of the soil in a peach orchard are the same as those used in the culture of other fruits or general farm crops, except, of course, that so far as the latter are concerned there is an opportunity for crop rotations that are not possible in an orchard.

It is always far better to maintain the fertility of the soil at a high standard than it is to permit it to become depleted to such an extent that restoration is necessary. Good tillage and the maintenance of an ample supply of humus or decaying vegetable matter in the soil will do much to keep it in a sufficiently productive condition for peach growing. But continuous tillage of the soil tends to deplete its content of humus unless it is renewed from time to time.

USE OF COVER CROPS.

Where stable or barnyard manure is abundant there is probably no more satisfactory way of supplying humus to the soil than by a liberal use of it. Manure is seldom obtainable, however, in sufficient quantity to meet any far-reaching needs. In its absence the use of cover or green-manure crops is to be advised.

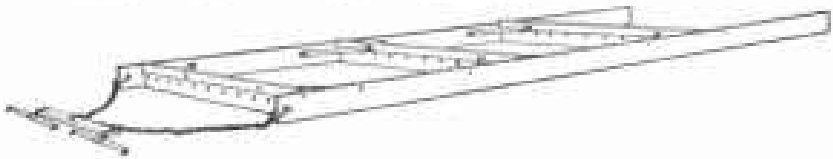

FIG. 8.—A leveler used in some sections for filling irrigation furrows, making the surface of the soil smooth, and pulverizing the clods.

A cover crop may contribute to the welfare of the orchard in a number of different ways. They have been enumerated as follows:[1]

(1) It directly improves the physical condition of the land; prevents hard soils from cementing or puddling; holds the rains and snows until they have time to soak away into the land; dries out the soil in spring, making early tillage possible; sometimes serves as a protection from frost.

(2) It catches and holds some of the leaching nitrates, of which the roots of trees are in little need late in the season; adds humus to the soil; renders plant foods available; appropriates nitrogen, if it is a leguminous crop.

The plants commonly used for cover-crop purposes fall into two groups—leguminous (or nitrogen-gathering) and nonleguminous. The former group comprises red clover, crimson clover, bur clover, field peas, vetch, cowpeas, and others; the nonleguminous group consists of rye, oats, buckwheat, millet, rape, turnips, and various others. Sometimes the growth of weeds or other more or less spontaneous growth is encouraged after the seasonal cultivation is ended, as a means of obtaining a cheap supply of vegetable matter for the soil.

[1] Bailey, L. H. Principles of Fruit Growing, p. 184–185 (1897 edition.

The range of usefulness of these different cover crops can not be discussed in detail in the present connection. It must suffice to mention a few of the most salient features. Red clover is more commonly used in apple orchards than in peach orchards, and especially when it is intended to omit tillage for a season. Vetch is apparently being used more and more as an orchard cover crop in the northern fruit districts. Crimson clover is especially satisfactory in some of the light soils in New Jersey and Delaware in seasons when there is a good supply of moisture in the soil at the time of seeding. Cowpeas are very widely used for this purpose in middle and southern latitudes.

Probably rye is the most widely used nonleguminous plant. It can be sowed late in the season, and it lives over winter and starts into growth early the next spring. All of these points are important considerations in many instances. But oats in combination with vetch have been especially satisfactory in some cases, and German millet has been shown to be almost an ideal nonleguminous cover crop under some of the conditions that prevail in Nebraska.[1]

In starting the cover crop, the usual practice is to sow the seed when the orchard is given its last cultivation for the season, usually in July or early in August, though the exact time is regulated by conditions. Sometimes cowpeas are planted in drills in June and tillage continued with a small cultivator. Where rye is used, it is commonly put in toward the close of the growing season.[2]

Whenever a cover crop is used in a peach orchard it should presuppose the plowing of the orchard as early in the spring as practicable, unless the growth that is on the ground can be worked into the soil effectively and more conveniently by the use of a disk or cutaway harrow. However, if there is an abundance of moisture in the soil, the turning under of the cover crop is delayed in many cases until after it has made considerable growth in the spring, in order to obtain as large a quantity of vegetable matter to be worked into the soil as is possible.

The use of cover crops is sometimes limited in particular seasons by lack of moisture. If there is a protracted drought at the time the seed should be put in and the trees are suffering therefrom, it may be unwise to make a further demand upon the moisture in the soil by sowing a cover crop, even though the soil may be known to lack humus. Under such conditions the cover crop might do more harm than good.

The conditions which prevail in certain districts of generally low precipitation in which peaches are being grown successfully are analogous to the above in some respects. In those districts continuous clean tillage, with the return of practically no vegetable matter to the soil, is bringing the ground into poor physical condition with the usual attending difficulties incident thereto. Stable

[1] Emerson, R. A. Cover crops for young orchards. Nebr. Agr. Exp. Sta. Bul. 92, 93 p., 12 fig., 1906.

[2] The amount of seed of the various cover crops commonly sowed per acre is as follows: Red clover, 10 to 15 pounds; crimson clover, 12 to 16 pounds; bur clover, 20 pounds; field peas, 1½ to 2 bushels; vetch, 1 bushel (60 pounds); cowpeas, 1 to 2 bushels; rye, 1½ to 2 bushels; oats, 2 to 2½ bushels; buckwheat, one-half to 1 bushel; millet, 1 to 1½ bushels; rape, 3 pounds; turnips, 3 pounds.

manure as a source of humus is not to be had in sufficient quantity to be of any real value, and the limited moisture supply is not sufficient to maintain the peach trees and grow a cover crop at the same time. This situation as it exists in some districts presents serious problems. The growers are beginning to realize its import.

Likewise in some irrigated districts where the water supply is limited, the need of a cover crop may have to be disregarded, either habitually or in seasons of unusual water shortage, because of the fact that there is not enough moisture to meet the demands of both the trees and the cover crop.

Aside from the usefulness of cover crops in maintaining the fertility of the soil, they may have important functions in other respects under some conditions. Where the topography or the character of the soil is such as to render it subject to washing, a cover crop which survives the winter will often prevent or materially lessen the erosion that would otherwise occur. If good tillage and the wise use of cover crops fail to produce optimum results in a peach orchard that is well situated, the use of commercial fertilizers may then logically receive consideration as a last resort.

USE OF FERTILIZERS.

Correspondents frequently write to the Department of Agriculture, asking, "What is the best fertilizer for a peach orchard?" "What fertilizer do you recommend for peaches?"—and other questions of similar purport. The only reply that can be made to such inquiries is that there is no "best" fertilizer for peaches and that no particular fertilizer can be recommended. A fertilizer which is economical to use and which gives maximum results in a particular orchard might be without appreciable effect in another orchard; but in the latter some other fertilizer perhaps might produce highly satisfactory returns.

The wise use of fertilizers in growing peaches, as for all other crops, is distinctly a local problem and depends upon local factors and conditions. If, for instance, the growth of the tree or the development of the fruit is limited by the amount of nitrogen which is available in the soil, then the application of potash or phosphoric acid would be of no avail and it would be throwing money away to apply them, so far as their effect upon the peach crop is concerned. In the same way, if potash is the "crop limiter," then the application of nitrogen or phosphoric acid would not bring the desired response. It is, of course, true that a complete fertilizer containing nitrogen, phosphoric acid, and potash might be expected, other things being favorable, to produce the desired results; but if the soil is deficient in only one of those plant foods, then the application of the others is equivalent to throwing away the money which is paid for them.

In the handling of soils with a view to maintaining them in a highly productive condition, it is a matter of fundamental importance

to ascertain what factor or factors are limiting the performance of the orchard. The limiting factor may be an insufficient supply of some kind of plant food, improper physical condition of the soil due to a lack of humus or poor drainage, or it may be something else. The real problem is to determine what the trouble is and then apply the proper remedy, if it is known.

Fertilizers are often largely without appreciable effect if they are applied to soils that are in poor physical condition, as when they are greatly lacking in humus. It is for this reason that attention should be given to the use of fertilizers only after the possibilities of tillage and the maintenance of the soil in good physical condition have been exhausted in the effort to produce fruit successfully.

It follows that the application of a complete fertilizer may give excellent results. But if there is an insufficient supply of only one plant food, then it may be assumed that the response from the fertilizer is due to the presence in it of that plant food of which there was an insufficient supply in the soil and that the other plant foods in the fertilizer were without any real value to the crop or trees. Obviously such a practice would be neither economical nor businesslike.

The wiser plan is to carry on a few experiments with a view to determining local needs. In arranging a series of experiments with this end in view a representative portion of the orchard should be selected. To a few trees—perhaps 5 or 6—an application of nitrogen should be made; to other trees, potash; and to still others, phosphoric acid. Different combinations of these plant foods should be applied to other groups of trees.

A detailed record needs to be made of the different applications and each group of trees treated the same way each season for several successive years. Gradually the results of the different fertilizer treatments will become apparent in the behavior of the trees, their growth and vigor, the productiveness and regularity of the crops, the quality of the fruit, and in other ways. From these results the grower who has carefully studied the conditions should be able to decide upon a rational basis for the use of fertilizers in his own orchard.

IRRIGATION.

Most of the peaches produced in the Intermountain States and west of the Rocky Mountains are grown under irrigation. This operation is therefore very obviously an important factor in the production of great quantities of peaches. It is unnecessary, however, to discuss its details in the present connection. Reference is made to it here primarily for the purpose of calling the attention of those who are concerned to Farmers' Bulletin 404, entitled "Irrigation of Orchards," which will be forwarded without cost by the Secretary of Agriculture.

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